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Huang et al.

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(54) **POWER-AUGMENTING TRANSMISSION
STRUCTURE FOR AN ELECTRIC CAR**

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F16H 59/00 (2006.01)
H02P 17/00 (2006.01)

(52) **U.S. Cl.** **74/337; 477/15**

(58) **Field of Classification Search** **74/330,**
74/331, 329, 340, 337.5, 425, 337, 640; 475/5;
477/15

See application file for complete search history.

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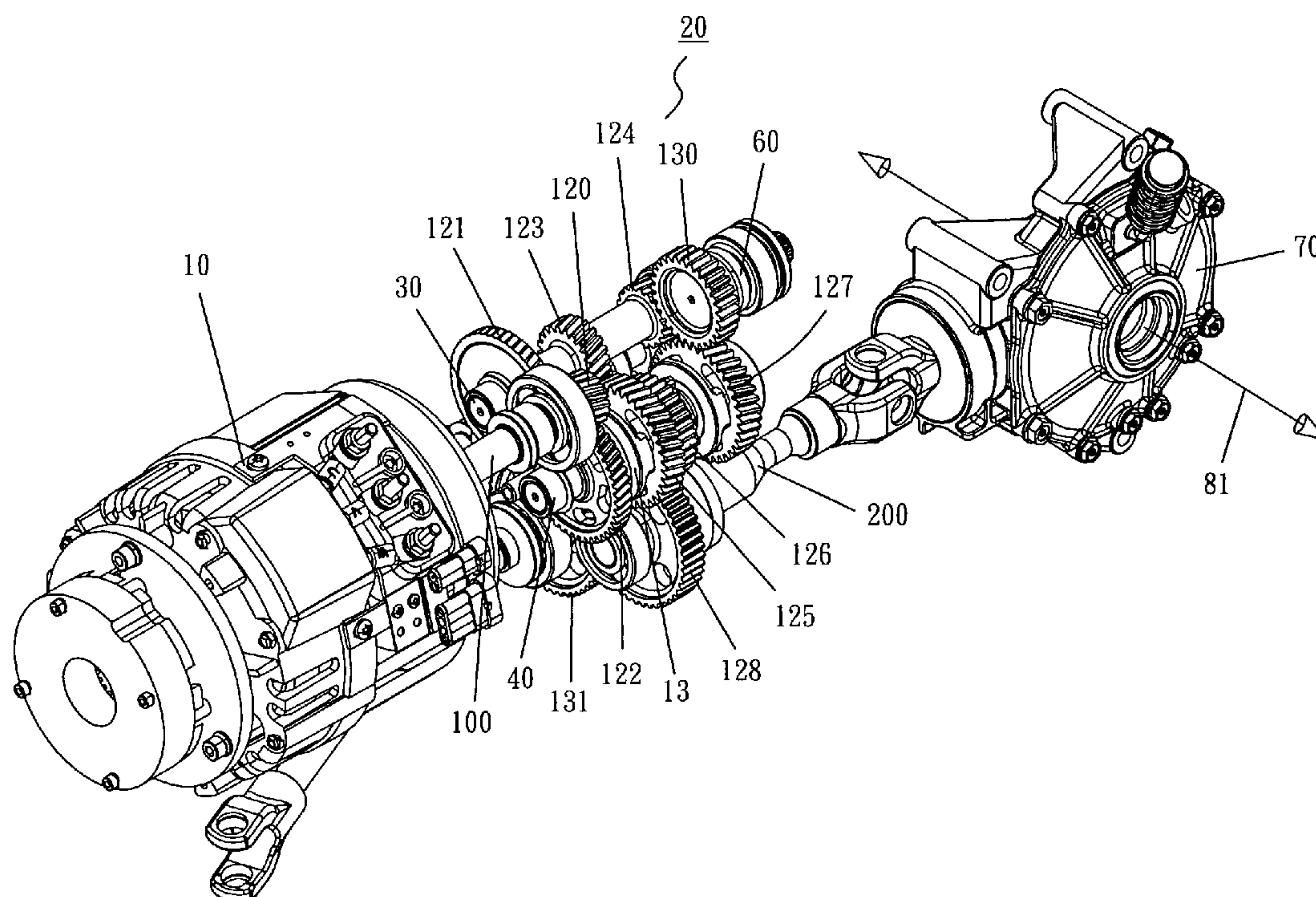
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(57) **ABSTRACT**

A power-augmenting gear structure for an electric car includes a low-speed and power-augmenting transmitting route additionally installed in a gear case, with an output shaft of an electric motor extending in the gear case. The gear case has transmission gears forming conventional normal speed transmitting routes with normal speed reducing ratio for running on common flat roads, and a low-speed and power-augmenting transmitting route to be used in case of moving up an upward slope or coping with a condition needing a large torque. Then the electric motor may be reduced in its size, weight and cost, without necessity of enlarging it to have a large power.

2 Claims, 15 Drawing Sheets



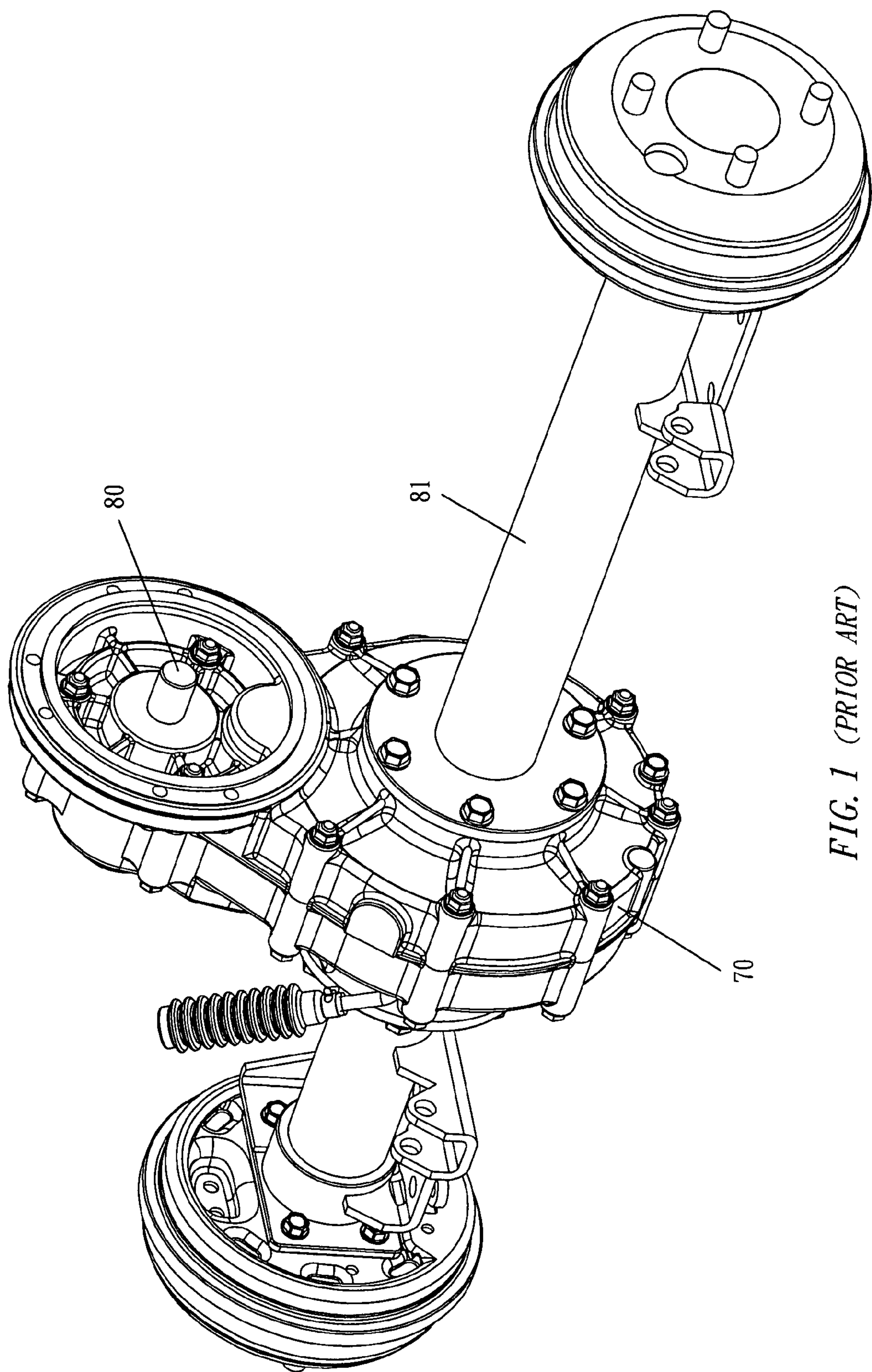


FIG. 1 (PRIOR ART)

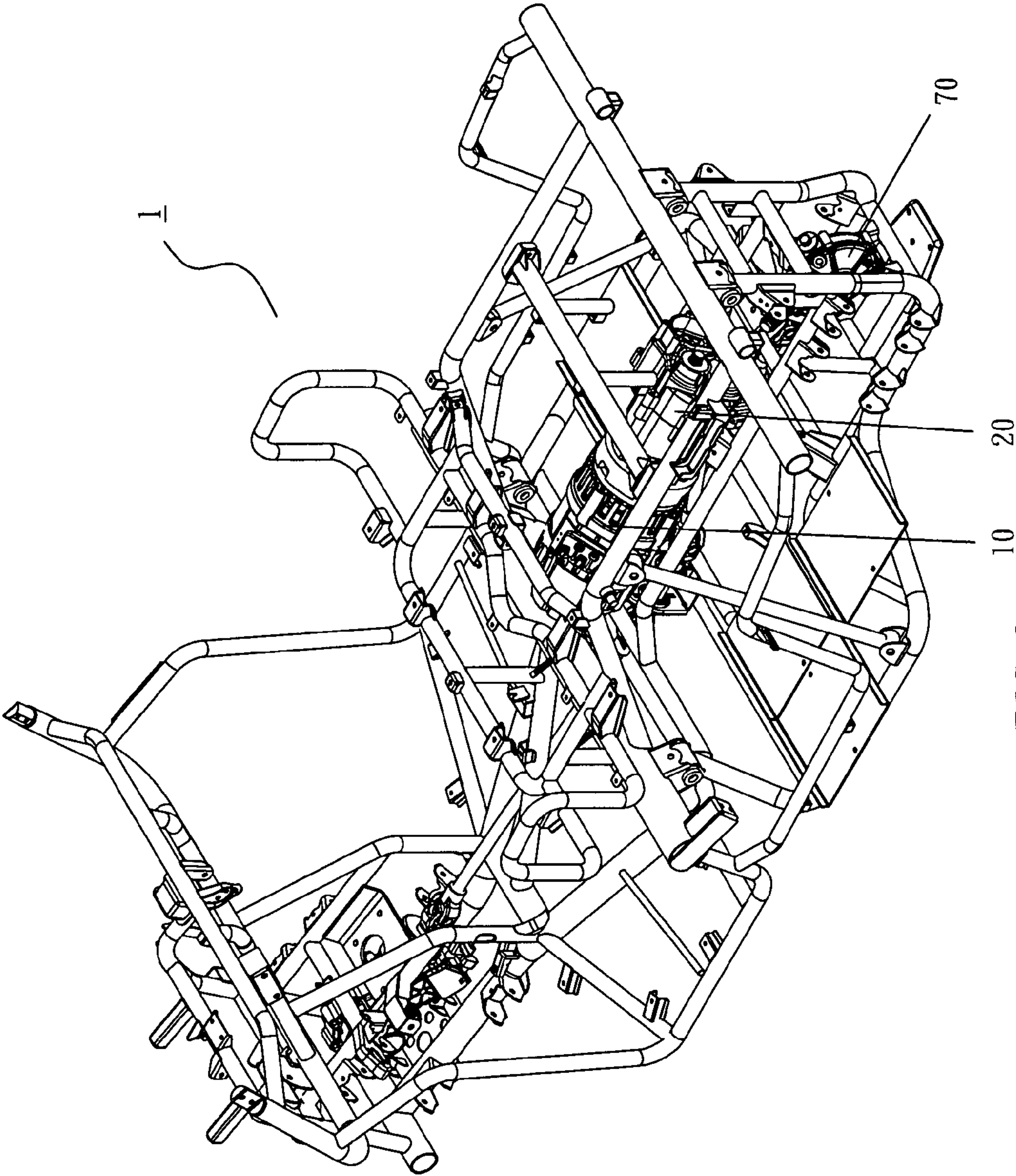


FIG. 2

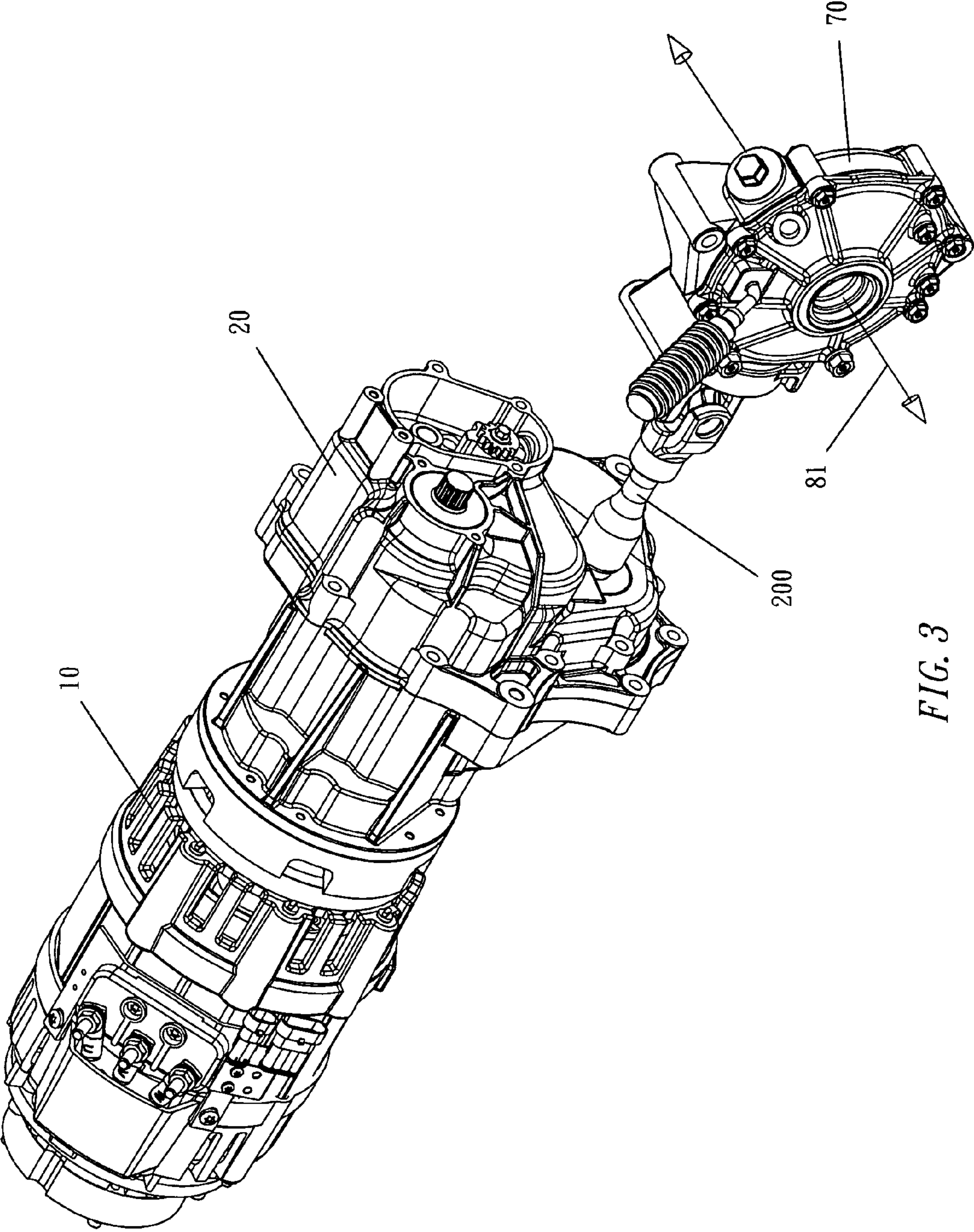
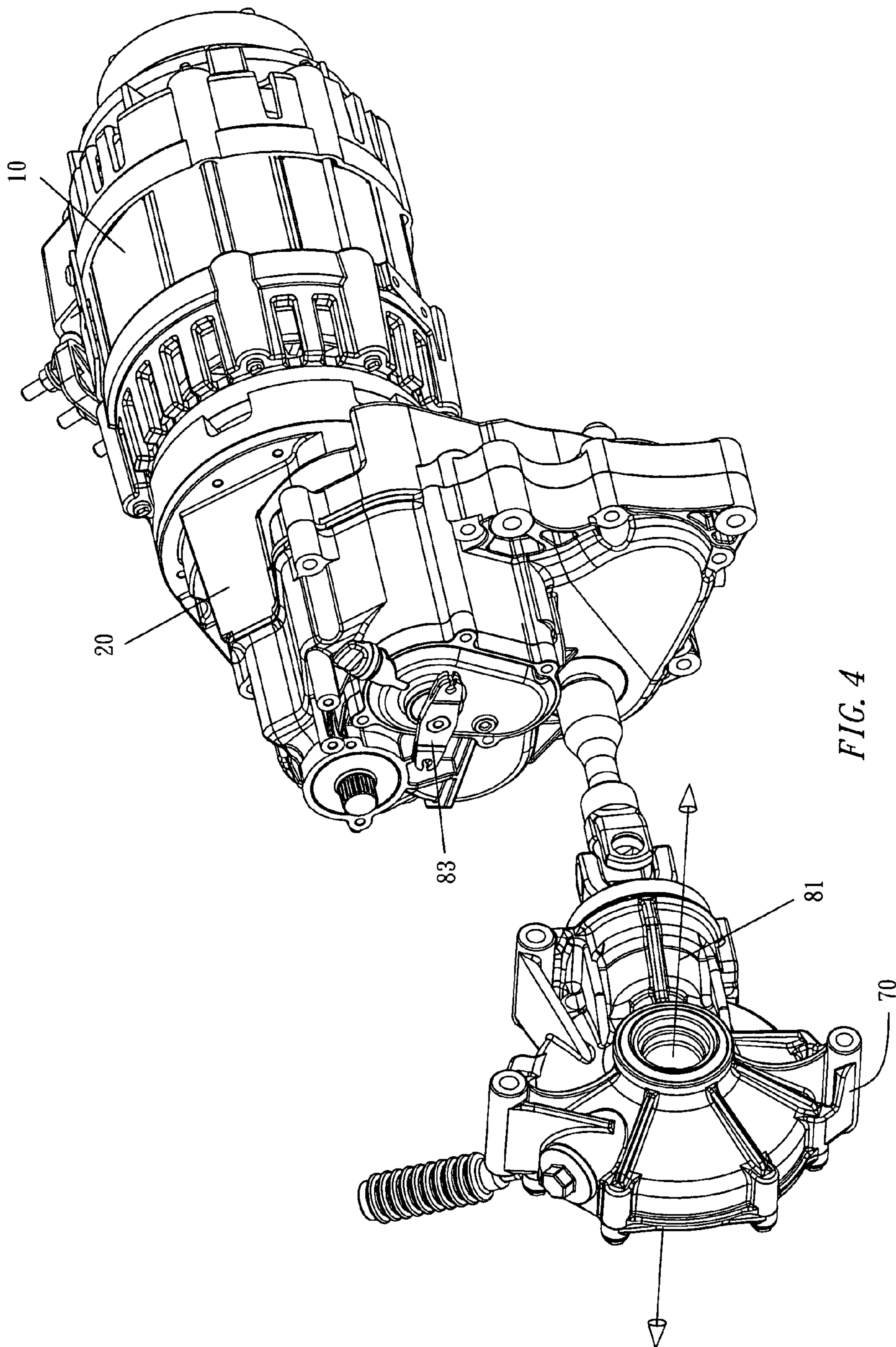


FIG. 3



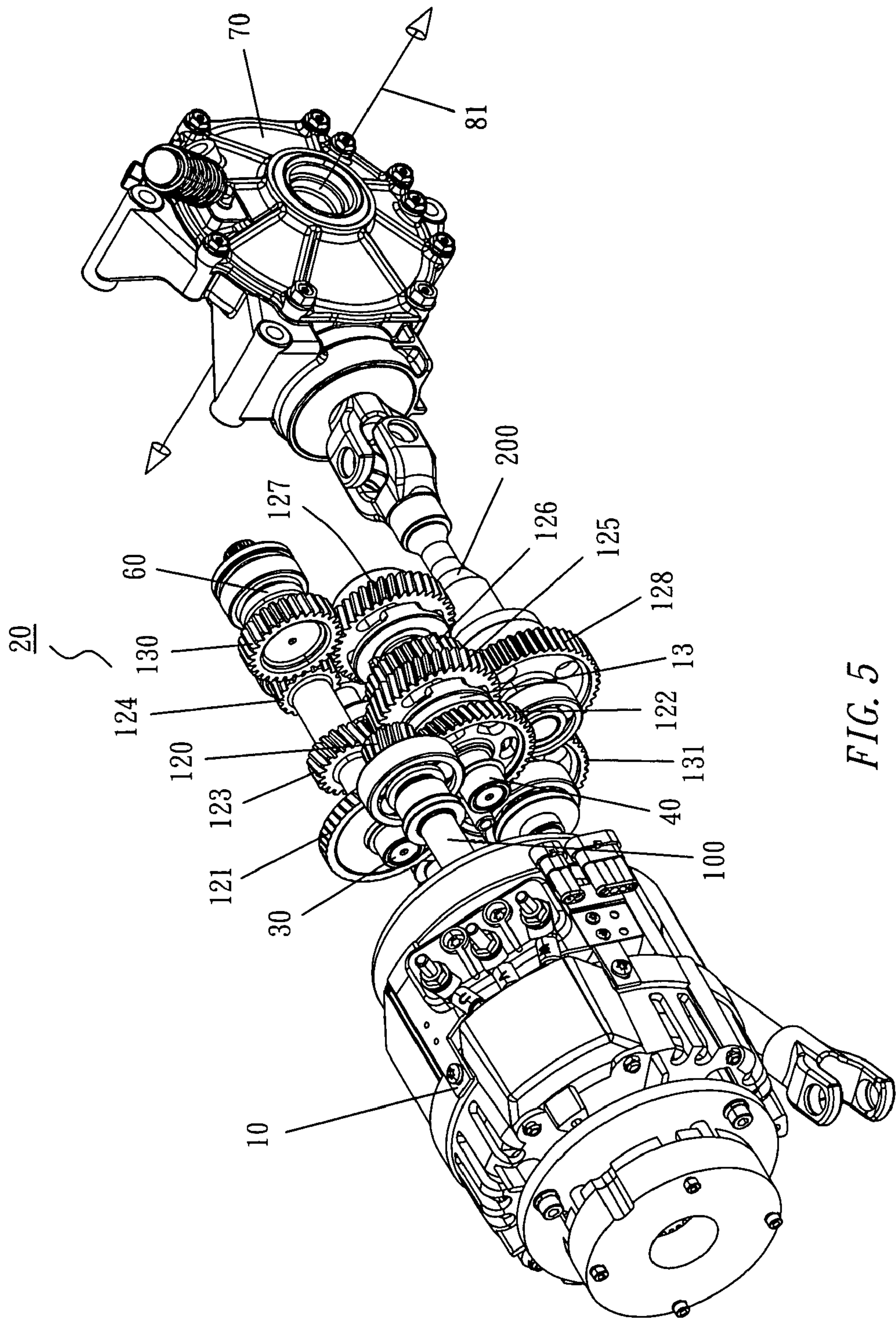
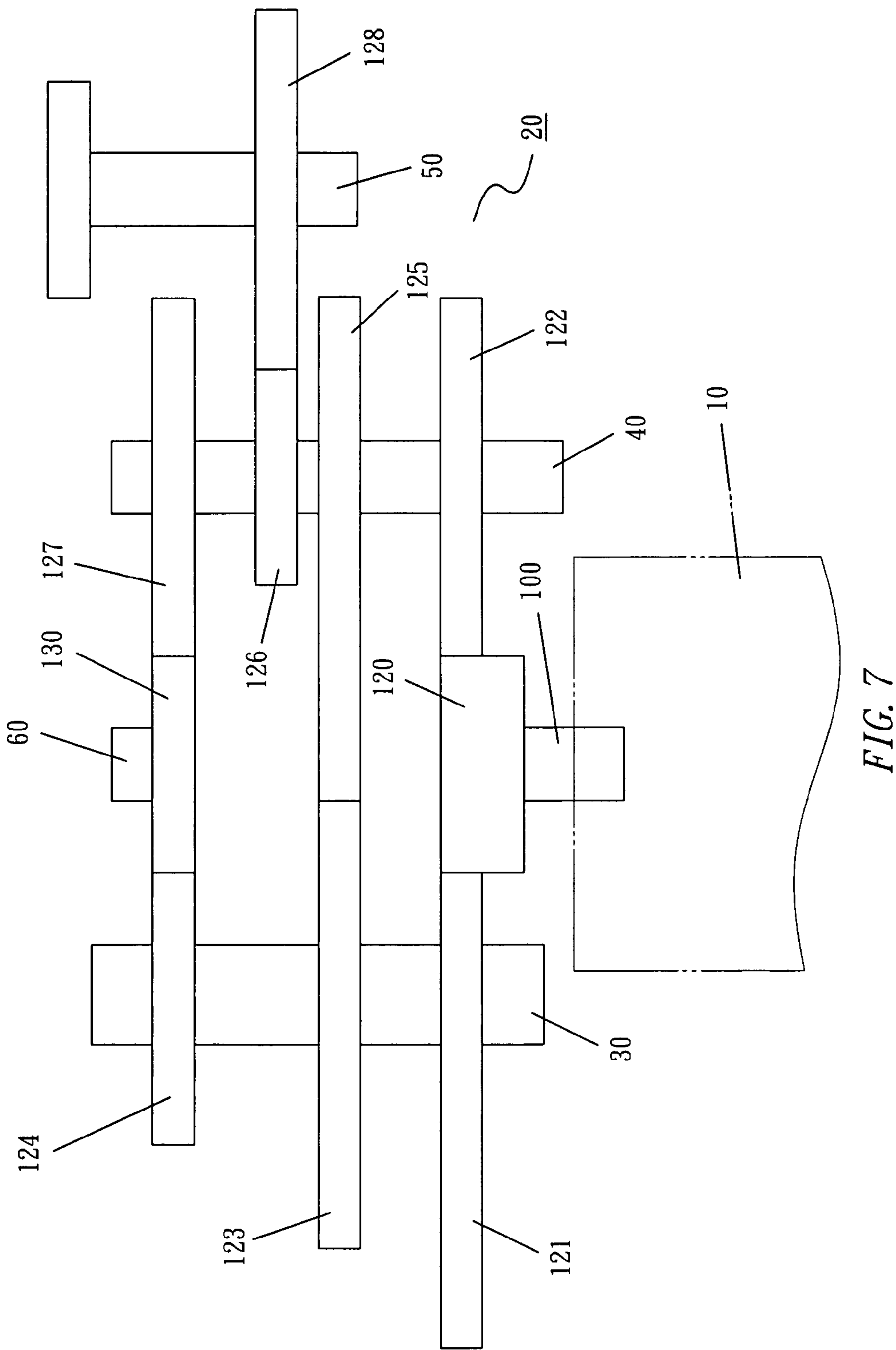


FIG. 5



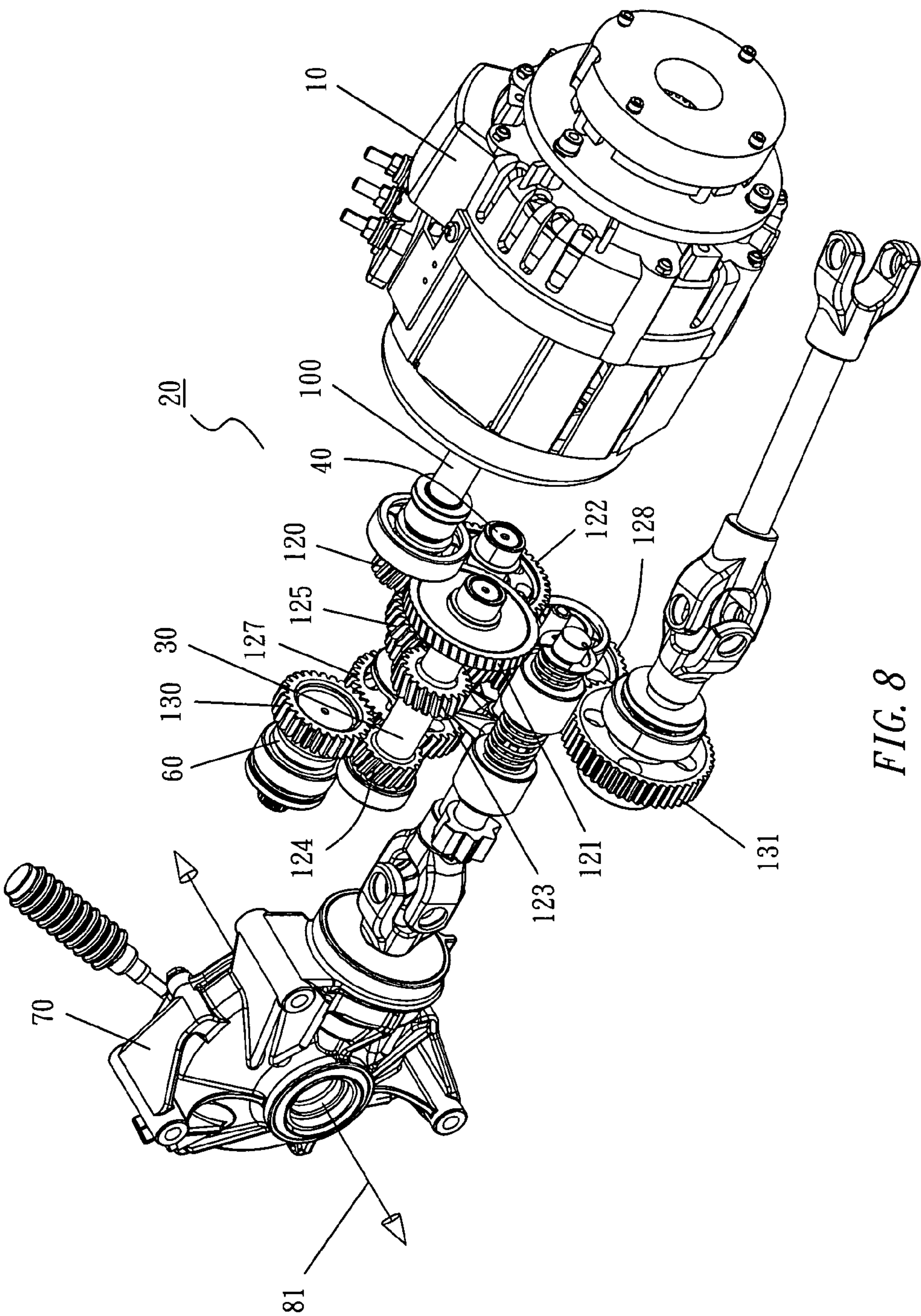
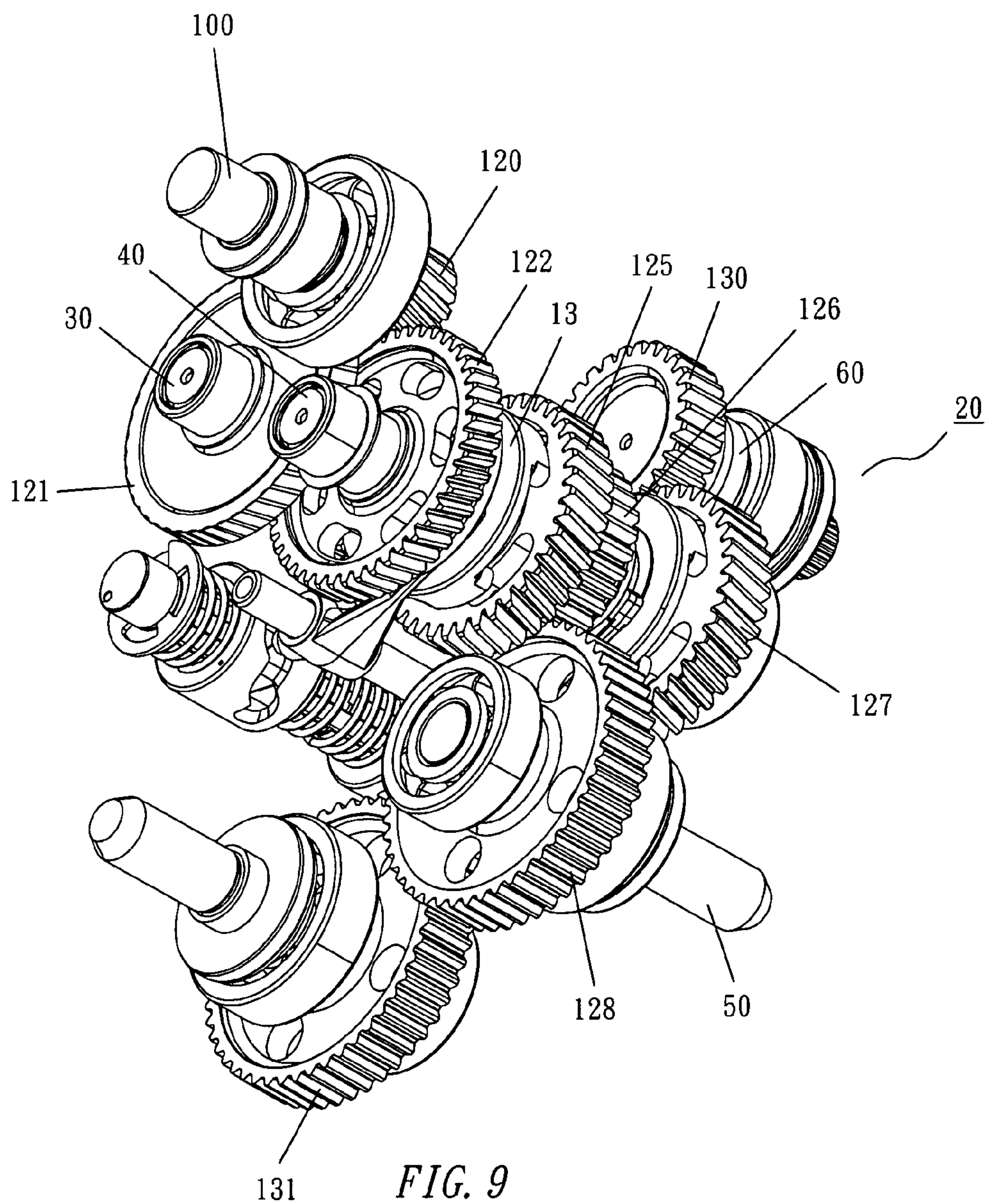


FIG. 8



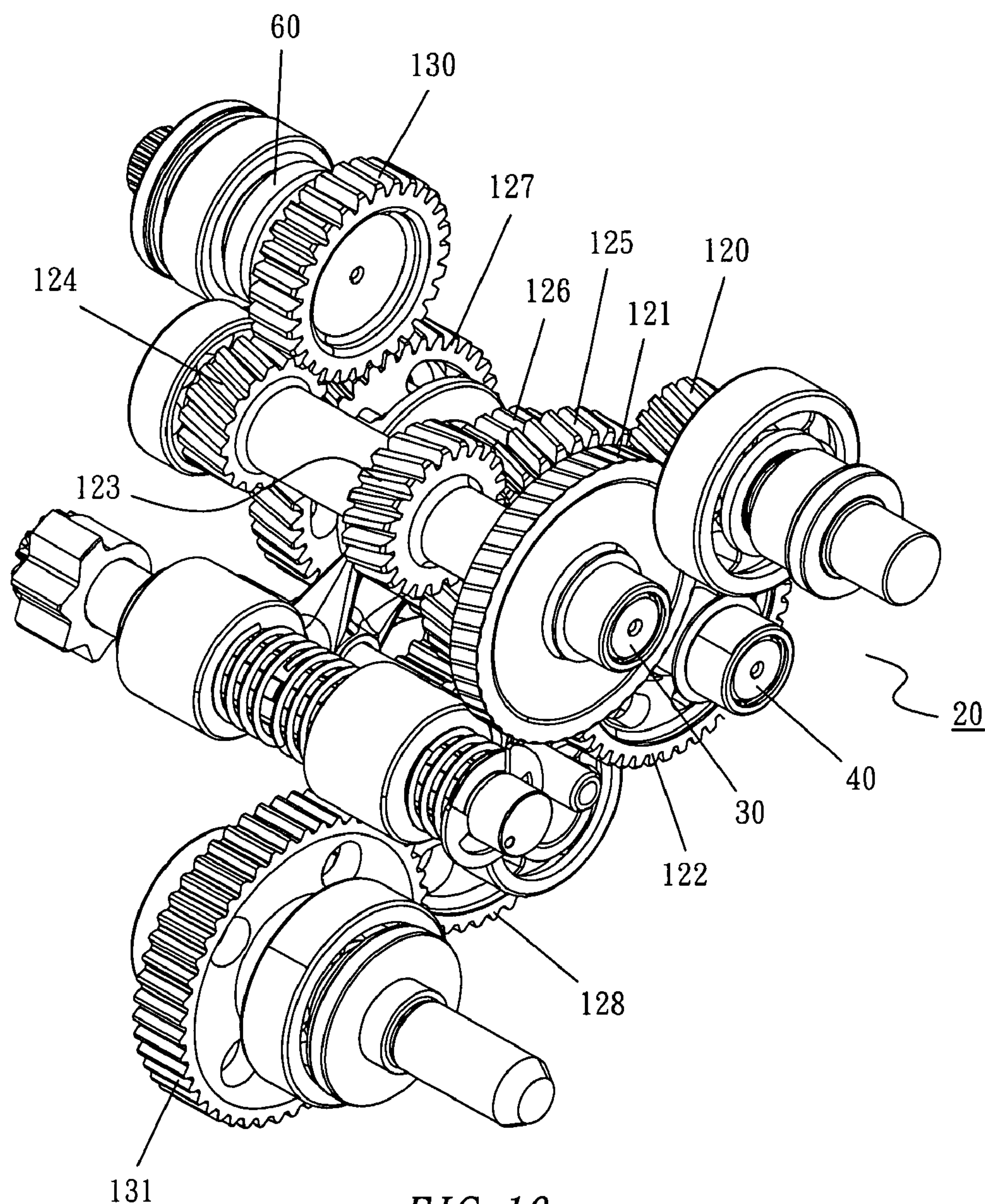


FIG. 10

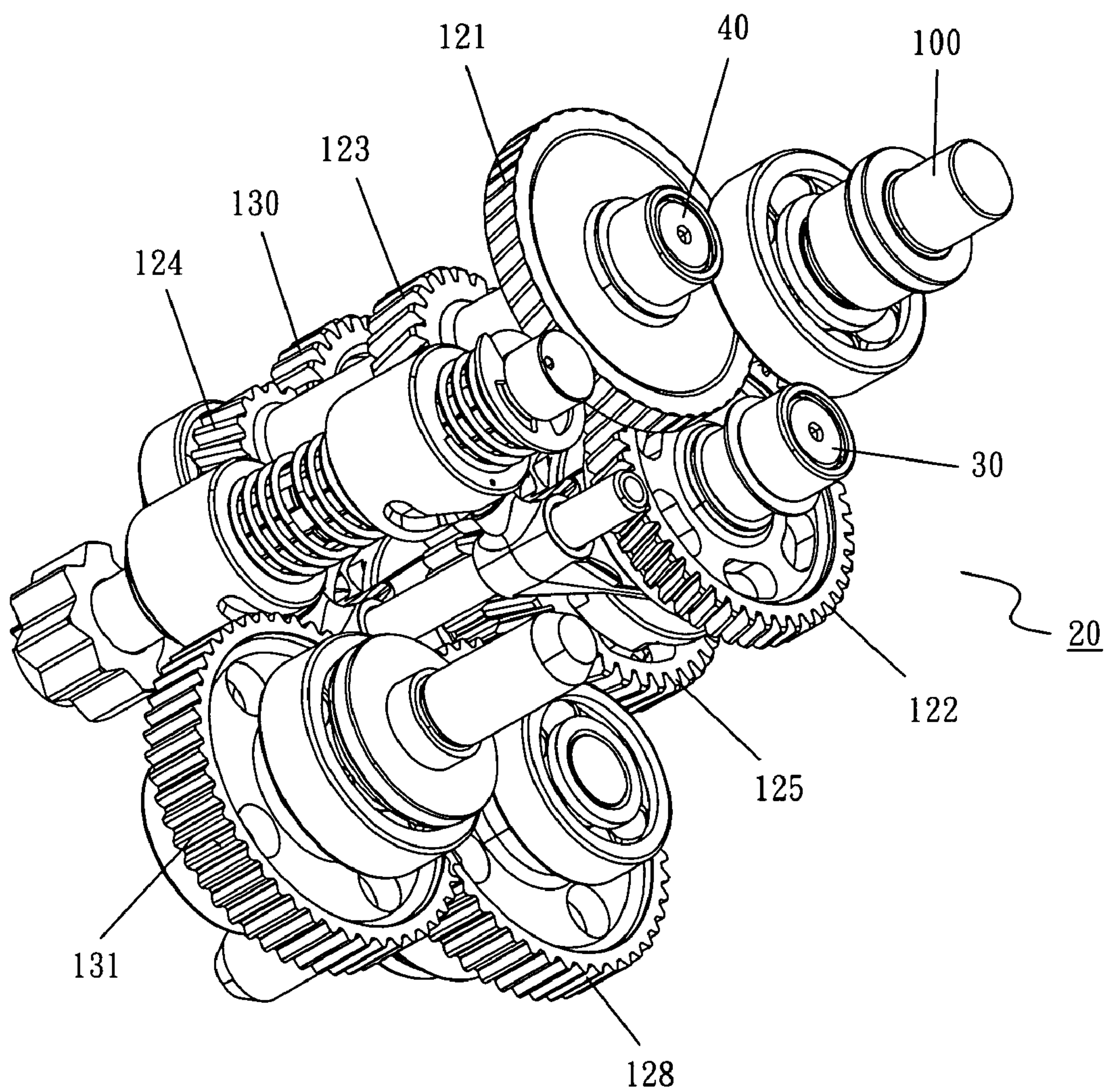


FIG. 11

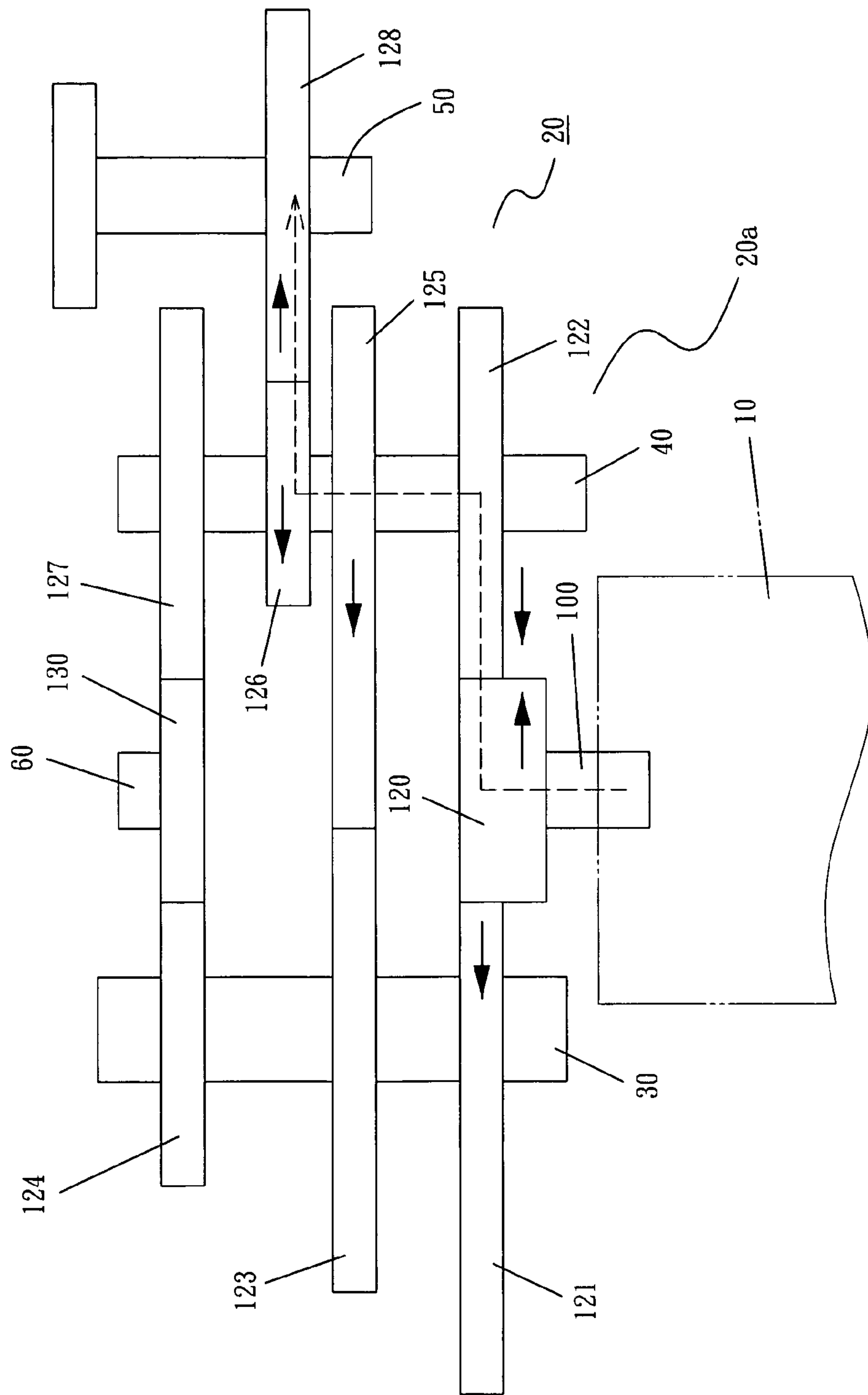


FIG. 12

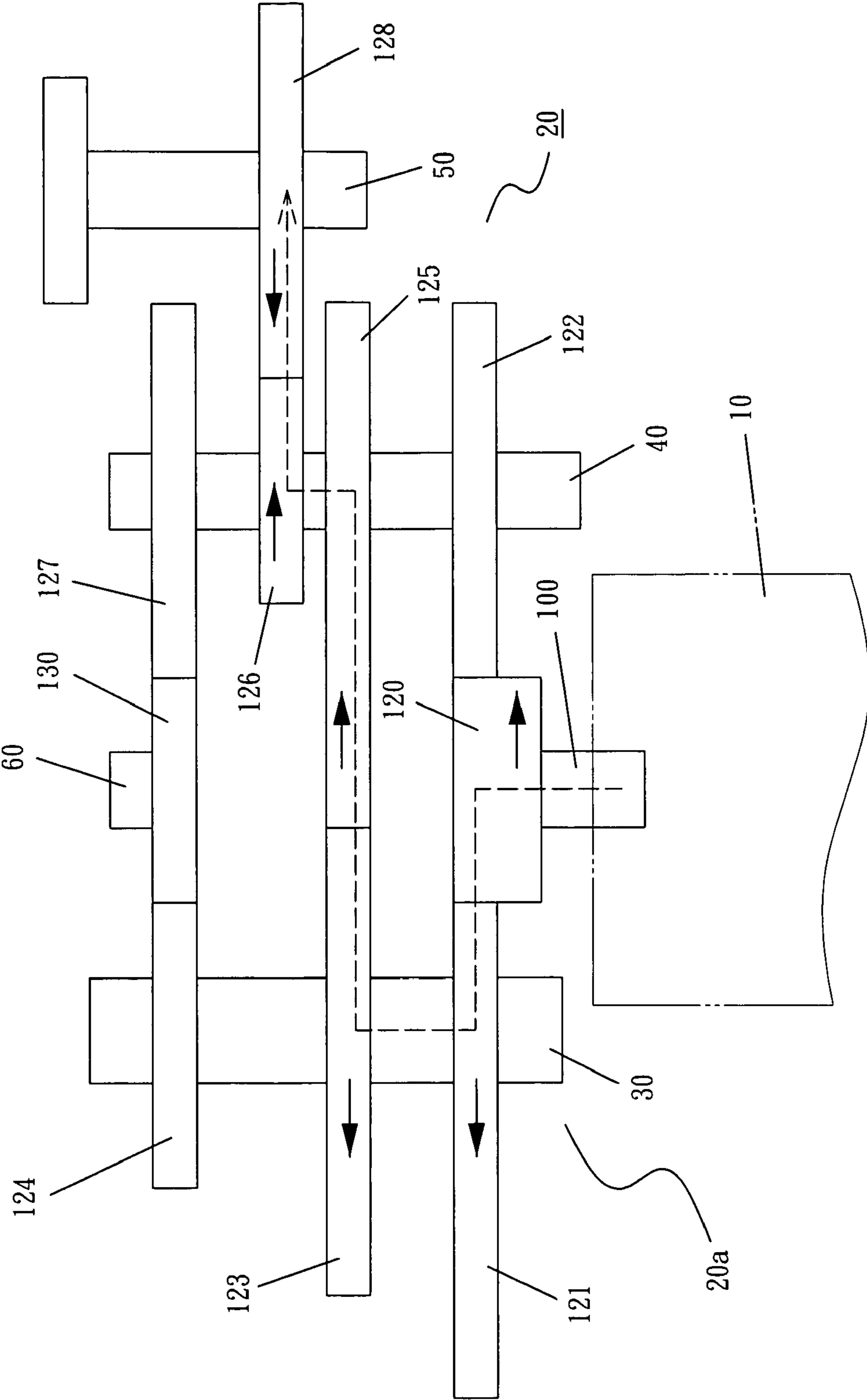


FIG. 13

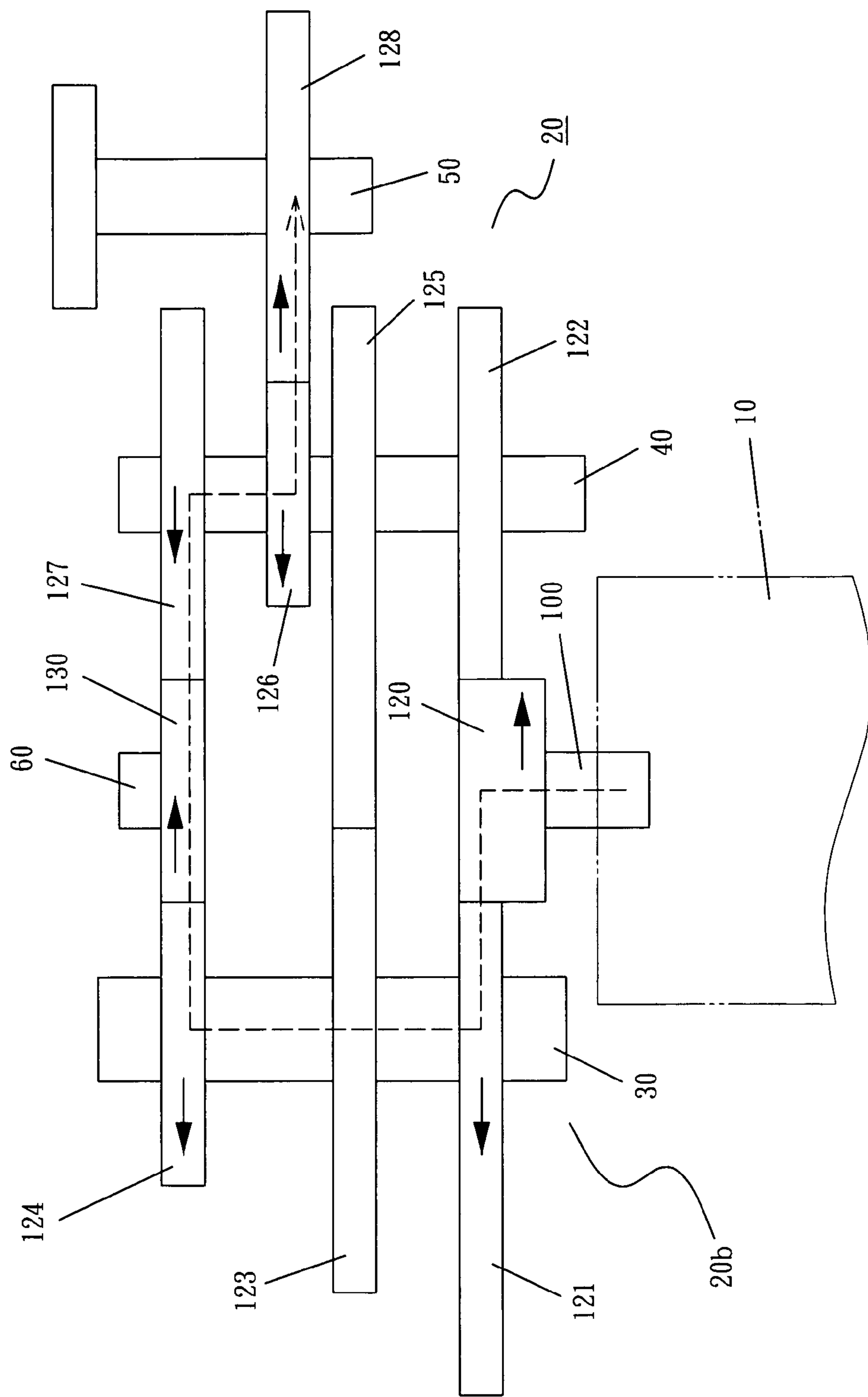
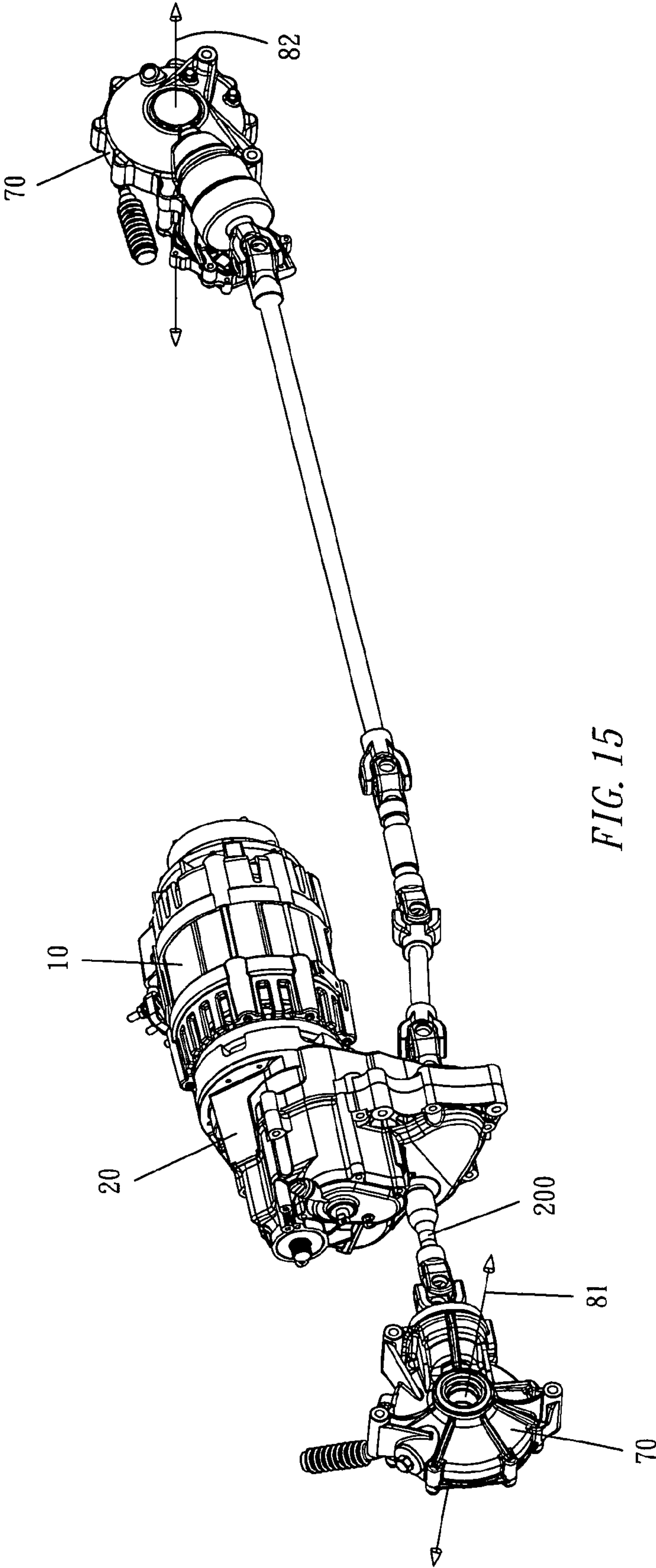


FIG. 14



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**POWER-AUGMENTING TRANSMISSION
STRUCTURE FOR AN ELECTRIC CAR****BACKGROUND OF THE INVENTION****1. Field of the Invention**

This invention relates to a low-speed and power-augmenting transmission structure for an electric car, particularly to one provided in a gear case for augmenting the power of an electric car so as to move up an upward slope easily without increasing the power of the electric motor of an electric car.

2. Description of the Prior Arts

Nowadays numerous industries in our society depend upon fossil oil, and especially transportation requires tremendously large quantity of gasoline and diesel refined from fossil oil. As consumption of fossil oil has gone up and up, the price of fossil oil has risen up to a surprising level, so related sectors have been struggling to find substitutes all over the world. Therefore electricity has become one of its substitutes, used in electric cars or hybrids, in order to reduce heavy dependence on fossil oil. A conventional electric car shown in FIG. 1 is mainly provided with a driving axle **80**, which drives a last gear **70**, and the last gear **70** then drives a rear wheel axle **81** to move the car forward or backward. However, a conventional electric car needs a very great power in case it runs up an upward slope, and manufacturers have to make the car and the electric motor larger to conquer this problem, and accordingly have to add up its cost and enlarge its body, in addition to the drawback that the rear wheel axle **81** becomes heavier to result in bad effect in its suspension.

SUMMARY OF THE INVENTION

This invention has an object to offer a low-speed power-augmenting transmission structure for an electric car, without changing the power of the electric motor so that the electric car can move up an upward slope easily or cope with a condition requiring a large torque.

The characteristic of the invention is a low-speed and power-augmenting transmission structure added to conventional general transmission gears provided in a gear case, so that an electric car may move up easily an upward slope or cope with a condition needing a large torque, belittling the largest power of an electric motor and accordingly reducing the size, weight and cost of the electric motor and its controller.

BRIEF DESCRIPTION OF DRAWINGS

This invention will be better understood by referring to the accompanying drawings, wherein:

FIG. 1 is a perspective view of the driving device of a conventional electric car;

FIG. 2 is a perspective view of a low-speed power-augmenting transmission structure for an electric car placed in the frame of an electric car in the present invention;

FIG. 3 is a perspective view of the power transmission system of an electric motor in the present invention;

FIG. 4 is another perspective view of the power transmission system of an electric motor in the present invention;

FIG. 5 is a perspective view of the interior of a gear case in the present invention;

FIG. 6 is a magnified perspective view of the interior of the gear case in the present invention;

FIG. 7 is a block diagram of the arrangement of the transmission gears in the present invention;

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FIG. 8 is another perspective view of FIG. 5 from another direction;

FIG. 9 is a perspective view of FIG. 6 from a second direction;

FIG. 10 is a perspective view of FIG. 6 from a third direction;

FIG. 11 is a perspective view of FIG. 6 from a fourth direction;

FIG. 12 is a flowing chart of the operation of the transmission system of the electric motor in moving forward at the general common speed in the present invention;

FIG. 13 is a flowing chart of the operation of the transmission system of the electric motor in moving backward at the general common speed in the present invention;

FIG. 14 is a flowing chart of the operation of the transmission system of the electric motor in moving in a lower-speed and power-augmenting transmission route in the present invention; and

FIG. 15 is a perspective view of the present embodiment with four wheels connected to be driven at the same time in the present invention.

**DETAILED DESCRIPTION OF THE PREFERRED
EMBODIMENT**

A preferred embodiment of a power-augmenting transmission structure for an electric car in the present invention, as shown in FIGS. 2-5, includes an electric motor **10**, an output shaft **100** of the motor **10**, several transmission gears installed in a gear case **20**, and an output shaft **200** of the gear case **20** for rotate a last gear **70**, which drives a wheel axle (a rear wheel axle or a front wheel axle).

The gear case **20** has a general common speed transmission route **20a** with a normal speed reducing ratio for running on common flat roads, and a low-speed and power-augmenting transmission route **20b** with a large speed-reducing ratio for moving up easily an upward slope or coping with a condition demanding a large torque.

The gear transmission system, referring to FIGS. 5-11, includes an output shaft **100** of the motor **10**, a first transmission gear **120** fixed on an end of the output shaft **100**, a second transmission gear **121** fixed on a first rotatable shaft **30**, a third transmission gear **122** fixed on a second rotatable shaft **40**, with the first gear **120** able to engage with the second gear **121** or the third gear **122** optionally by means of a clutch. The second and the third gear **121** and **122** have the same number of teeth. The gear transmission system further includes a fourth transmission gear **123** and a fifth transmission gear **124** fixed orderly on the first rotatable shaft **30** with the first gear **121** fixed thereon and having less teeth than the first gear **121**. The fourth and the fifth gear **123** and **24** may rotate synchronously with the first gear **121**, as shown in FIGS. 7 and 8.

Furthermore, the gear transmission system has a second rotatable shaft **40**, which is provided with a clutch **13**, and a sixth transmission gear **125**, a seventh transmission gear **126** and an eighth transmission gear **127** fixed orderly on the second rotatable shaft **40** that the third gear **122** is fixed on. Then the fourth gear **123** engages with or disengages from the sixth gear **125** by means of the clutch **13** as shown in FIGS. 6 and 7. The gear transmission system further includes a third rotatable shaft **50** in parallel to the first and the second rotatable shaft **30** and **40**, with a ninth transmission gear **128** engaging with the seventh gear **126** fixed thereon, and a fourth rotatable shaft **60** fixed with a guide gear **130** installed between the fifth gear **124** and the eighth gear **127** and engag-

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ing with the both gears **124** and **127** at the same time. Thus, the fifth gear **124** may reverse the rotating direction of the eighth gear **127**.

Moving forward and backward of an electric car is handled by a gear lever **83** and a clutch by a driver, as shown in FIG. **4**, but this is a conventional method, its description is omitted there.

Then the flowing operation of the gear transmission system of the electric motor **10** is described now. In case of getting into the forward running mode, the motor **10** runs at the general common speed transmission route **20a** as shown in FIG. **12**, its transmitting order starts from the output shaft **100** to the first gear **120**, then to the third gear **122** (on the second rotatable shaft **40**), then to the seventh gear **126**, then to the ninth gear **128**. More precisely, the motor **10** moves the first gear **120**, which then rotates the third gear **122** and the second rotatable shaft **40** at the same time, and then the second shaft **40** rotates the sixth gear **125** and the seventh gear **126**, so the seventh gear **126** rotates the ninth gear **128**. Finally the ninth gear **128** drives the driving axle to move the car forward.

In case of moving back the car, the gear lever is handled to change to the moving back transmission route. Then the third gear **122** is disengaged from the first gear **120** by means of the clutch, and the transmission system of the motor **10** operates at the general common transmitting speed route **20a** as shown in FIG. **13**, so the transmitting order starts from the output shaft **100** to the first gear **120**, then to the second gear **121** and the first rotatable shaft **30** at the same time, then to the fourth gear **123**, then to the sixth gear **125** and the second rotatable shaft **40** at the same time, then to the seventh gear **126**, and then to the ninth gear **128**. More minutely, the motor **10** rotates the first gear **120**, which then rotates the second gear **121**, so the first rotatable shaft **30** is rotated to move the fourth gear **123**, which then rotates the sixth gear **125**, so the sixth gear **125** rotates the second rotatable shaft **40**, which then rotates the seventh gear **126** to move the ninth gear **128**, so finally the car is driven to move back.

Next, when an electric car is to move up an upward slope or to have the power increased, the transmission gear system is set at the low-speed and power-augmenting transmitting route **20b** as shown in FIG. **14**, then the operation order begins from the output shaft **100** to the first gear **120**, then to the second gear **121**, then to the first rotatable shaft **30**, then to the fifth gear **124**, then to the guide gear **130**, then to the eighth gear **127**, then to the second rotatable shaft **40**, then to the guide gear **130** to align the rotating direction of the fifth gear **124** to that of the eighth gear **127**, so that the second rotatable shaft **40** rotates the seventh gear **126**, which then rotates the ninth gear **128**. In this way, the electric car does not need to enlarge the power of the electric motor **10**, by means of the design of the speed reducing ratio of the first rotatable shaft **30** and all the transmission gears in addition to the rotating-direction reversing method effected by the guide gear **130** and the fifth gear **124** and the eighth gear **127**.

Moreover, if the electric car is needed to have a four wheel driving function, it is only required to install a front wheel driving gear **131** that is made to engage with the ninth gear **128** as shown in FIGS. **8-11**, driving the front wheel axle **82** in conjunction of the rear wheel driving function, as shown in FIG. **15**.

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In this invention, by adding the low-speed and power-augmenting transmitting route **20b** to the general common speed gear route **20a** having a normal speed reducing ratio for running on common flat roads, the electric motor does not need to be enlarged and can have a large torque to move up easily an upward slope or to cope with a condition needing a large output power, reducing the size, the weight or the cost of the car.

While the preferred embodiment of the invention has been described above, it will be recognized and understood that various modifications may be made therein and the appended claims are intended to cover all such modifications that may fall within the spirit and scope of the invention.

What is claimed is:

1. A power-augmenting transmission structure for an electric car, said structure comprising a gear transmission system consisting of an electric motor, an output shaft provided in said electric motor, a gear case wherein a plurality of transmission gears are installed, said output shaft driving one of said transmission gears optionally, said gear case provided with an output shaft for driving a last one of said transmission gears so that said last gear may drive a driving axle; and

wherein said gear case is installed with general common speed transmitting routes with a normal speed reducing ratio and a low-speed and power-augmenting transmitting route, said general common speed transmitting routes used for running on common flat roads, said low-speed and power-augmenting transmitting route used for moving up easily an upward slope or coping with a condition needing a large torque;

wherein said gear case has said general common speed transmitting routes and said low-speed power-augmenting transmitting route, provided with a first transmission gear fixed on an output shaft of an electric motor, a first rotatable shaft fixed thereon with a second transmission gear, a fourth transmission gear with fewer teeth than said second gear, and a fifth gear with fewer teeth than said fourth gear; a second shaft provided with a clutch and fixed thereon with a third transmission gear, a sixth transmission gear, a seventh transmission gear and an eighth transmission gear; said first gear engaging with and rotating said second gear and said third gear, said fourth gear and said sixth gear able to engage with or disengage from each other by means of said clutch; a third rotatable shaft having a ninth transmission gear fixed thereon, said ninth gear engaging with said seventh gear so that said third rotatable shaft may transmit power; a fourth rotatable shaft having a guide gear fixed thereon, said guide gear located between said fifth gear and said eighth gear and engaging with said fifth gear and said eighth gear; said electric car increasing its power at a low speed by means of said first rotatable shaft together with all said transmission gears with the set speed reducing ratio in addition to said guide gear capable to let said fifth gear and said eighth gear rotate in a same direction.

2. The power-augmenting gear structure for an electric car as claimed in claim 1, wherein said ninth gear engages with a set of front wheel driving gears extra added, making said electric car provided with four wheel driving function.

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